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Centre for Market and Public Organisation
Bristol Institute of Public Affairs
University of Bristol
2 Priory Road
Bristol BS8 1TX

Tel: (0117) 33 10799
Fax: (0117) 33 10705
E-mail: cmpo-office@bristol.ac.uk

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Manoel F. Bittencourt

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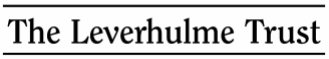

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Inflation and Finance: Evidence from Brazil

Manoel F. Bittencourt[1]

[1]Department of Economics, University of Bristol,
8 Woodland Road, Bristol BS8 1TN, UK

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Abstract

In this paper we examine the impact of inflation on financial development in Brazil. The data available permit us to cover the eventful period between 1985 and 2002 and the results-based initially on time series and then on panel time series data and analysis, and robust for different estimators, specifications and financial development measures-suggest that high and erratic rates of inflation presented deleterious effects on finance at the time. The main policy implication arising from the results is that poor macroeconomic performance, exemplified by high rates of inflation, can only have detrimental effects on finance, a variable that is important for directly affecting, e.g., economic growth and development, and income inequality. Therefore, low and stable inflation is a necessary first step to achieve a more inclusive and active financial sector with all its attached benefits.

Keywords: Financial development, inflation, growth, inequality, Brazil.

JEL Classification: E31, E44, O11, O54

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Address for Correspondence
CMPO, Bristol Institute of Public Affairs
University of Bristol
2 Priory Road
Bristol
BS8 1TX
mb9591@bristol.ac.uk
www.bris.ac.uk/Depts/CMPO/

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1 Introduction and Motivation

The distortions caused by high rates of inflation on certain economic variables have been consistently studied for being of crucial importance for the (mal) functioning of an economy. Firstly, high inflation is detrimental to economic growth and development. More specifically, De Gregorio (1993), Fischer (1993), Barro (1995), Bullard and Keating (1995), Clark (1997), Barro (1998), Bruno and Easterly (1998), and Fischer (2005), study the effects of inflation on growth and the results they report—based on international cross-section, time-series and panel data—confirm the fact that *high* inflation outweighs the Mundell-Tobin effect, and therefore presents a detrimental effect on growth. Complementary to that, Cooley and Hansen (1989) and De Gregorio (1993), highlight the fact that higher inflation has the effect of reducing labour supply, and consequently to reduce growth.

Secondly, high inflation is also bad for income inequality. For example, Cardoso, Barros, et al. (1995), Barros, Corseuil, et al. (2000), Ferreira and Litchfield (2001), and Bittencourt (2005)—utilising time series, panel, and panel time series analysis—report that the *high* rates of inflation existent in Brazil in the 1980s and first half of the 1990s were significantly regressive on inequality, and therefore did offset any progressive effect supposedly coming from the debtor and creditor channel[1].

Hence, high rates of inflation signifies, firstly, reduced investment spending and a substitution from labour supply to leisure, which directly and negatively affects growth and capital accumulation; and secondly, it signifies increased inequality, for indexation—and all that it entails—is assumed to be an imperfect mechanism of protection against galloping inflation, hence it affects inequality by offsetting the creditor and debtor channel[2] [3].

[1] Alternatively, e.g. Blinder and Esaki (1978), and Romer and Romer (1999), report that *moderate* inflation presents progressive effects on inequality in the US precisely via the debtor and creditor channel which keeps the debts of the poor fixed at least in the short run.

[2] Agénor and Montiel (1999) cover the issue of under and over indexation (low and high wages, respectively) in developing countries that presented high rates of inflation in the 1970s, 1980s and early 1990s. Moreover, Sturzenegger (1992), Erosa and Ventura (2002), and Cysne et al. (2005) show that the rich are able to hold currencies and a consumption bundle that are not affected by the inflation tax. Hence, the rich, when compared to the poor and middle classes, benefit from high inflation. Furthermore, Crowe (2006) argues that macroeconomic stabilisation took so long to take place in, e.g. Brazil because the rich have always benefited from high inflation.

[3] For a more thorough survey on the costs of inflation, see Briault (1995) or Fischer

On the other hand, in a seminal study, Schumpeter (1936) highlights how important credit is for economic growth and development. The Schumpeterian analysis is based on the idea that credit, when in the hands of the 'entrepreneur', is conducive of growth[4]. Following that lead, King and Levine (1993), Levine and Zervos (1998), Beck, Levine, et al. (2000), and Beck and Levine (2004)—using cross-sections and panels of countries, and covering the period between 1960 and 1998—report that different measures of financial development have a positive impact on long-run growth[5].

Furthermore, finance is known to present progressive effects on economic inequality and poverty. Li, Squire, et al. (1998), Dollar and Kraay (2002), Clark, Xu, et al. (2003), Honohan (2004), Beck, Demirguc-Kunt, et al. (2004), Bonfiglioli (2006) and Bittencourt (2006), employing different sorts of data and analysis, report that finance reduces either inequality or poverty[6].

Therefore, financial development is important because it channels credit to be utilised by the 'entrepreneur' in promoting productive investment that positively alters the normal 'flow' of an economy, and therefore enhances growth and development. Moreover, finance facilitates investment in, e.g. short and long-run productive activities, which reduces the social immobility of the poorer relative to the richer, and consequently alleviates-reduces inequality.

Thus, determining what causes financial development in a major developing country like Brazil—which has presented historically high inequality and erratic growth rates, and extremely high and volatile rates of inflation for a long period of time—is important because finance can have the aforementioned incremental effect on growth and development, and a progressive effect on inequality. In other words, finance can display a double welfare improvement effect on to two of the most important economic problems faced

(2005).

[4]Schumpeter expertly writes "credit is essentially the creation of purchasing power for the purpose of transferring it to the entrepreneur, but not simply the transfer of existing purchasing power. The creation of purchasing power characterises, in principle, the method by which development is carried out in a system with private property and division of labor", Schumpeter (1936).

[5]For a thorough survey on the literature of finance and growth, see Levine (2004).

[6]On the theoretical side, Loury (1981), Greenwood and Jovanovic (1990), Galor and Zeira (1993), Banerjee and Newman (1993), Aghion and Bolton (1997), and Piketty (1997), highlight the fact that more widespread credit reduces inequality via the investment in productive-activities channel.

by Brazil, and by other developing countries too.

On the other hand, inflation—for having being used many times before as a proxy for macroeconomic performance, and given its erratic nature—arises as a natural and important macroeconomic determinant of financial development in Brazil. Intuitively speaking, galloping inflation increases macroeconomic uncertainty (a drastic disinflationary policy is expected to be implemented at some point, however the timing is uncertain)—it reduces the returns on savings and the incentives of savers, therefore reducing the amount of finance or credit provided in an economy—which in turn leads to the mentioned deleterious consequences on growth and development, and inequality. Hence, in this paper we examine closely the statistical and economic relationship which exists between inflation and financial development in Brazil. Although this is a subject that presents a solid theoretical base, empirical studies are still scarce.

Choi, Smith, et al. (1996), and Azariadis and Smith (1996), highlight the fact that if inflation is high enough, returns on savings are reduced—which leads to a reduction in savings and savers alike, the pool of borrowers is swamped, informational frictions become more severe—and therefore credit becomes scarce in such an economy. On a slightly different strand, Schreft and Smith (1997), Boyd and Smith (1998), Huybens and Smith (1998), and Huybens and Smith (1999), explore the idea that economies with higher rates of inflation do not approach or reach the steady state point where their capital stocks are high, i.e. there are bifurcations and development traps arise in such economies. Furthermore, these economies obviously present less efficient financial markets because of the higher interest rates that follow high rates of inflation.

On the empirical side, Haslag and Koo (1999), and Boyd, Levine, et al. (2001), using cross-sectional and panel international data from the 1960s to early 1990s, report that moderate inflation has a negative impact on financial development, as theoretically predicted. Moreover, both studies find evidence of nonlinearities, i.e. after a particular threshold—15 percent per year in Boyd, Levine, et al. (2001)—inflation presents only smaller marginal negative effects on finance. The intuition, not backed by theory though, is that the damage on finance is done at rates of inflation lower than the proposed threshold.

Having said that, we use data, mainly from the Brazilian Census Bu-

reau and the Brazilian Central Bank, covering the period between 1985 to 2002 and ten diverse and major regions, to better examine the relationship between inflation and finance. These sort of data that present a larger time-series T dimension than the panel N variation, i.e. $T \succ N$, permit us to explore the time-series variation, more related to the short-run, and also the important regional or panel variation present in the data. Furthermore, this time span is particularly interesting because it encapsulates two distinct periods in terms of macroeconomic performance in Brazil. The period between 1985 and 1994 covers the time when the rates of inflation were extremely high and volatile, reaching an astounding 82.18 percent *per month* in March 1990. However, from 1995 onwards, after the implementation of the Real Plan[7], inflation has been consistently stable and somehow much lower, and macroeconomic performance significantly improved[8].

The empirical evidence that we report, based initially on the time series $T \to \infty$ variation, and then on panel time series data and analysis, confirms the predictions that inflation is bad for financial development. The evidence is significant, and robust for different data sets, different measures of financial development, different specifications, and different estimators. The main policy implication emerging from this evidence is that high and volatile rates of inflation have a clear detrimental effect on a variable that is known to play an important role on economic growth and development, and economic inequality. Therefore, it can be said that low (high) and stable (unstable) inflation is a target that must (not) be consistently pursued in Brazil if it is to have a more sophisticated and inclusive financial structure with all its attached benefits. What follows from the above is that clear fiscal rules, which avoid large deficits that will eventually cause inflation to rise, and a more independent and transparent central bank must be in place in developing countries in general so that these countries can then reap the benefits of stability.

What distinguishes this paper from previous studies is that, firstly, we

[7] The stabilisation plan that was gradually implemented during the first half of 1994. The Real (R$) itself was introduced in July 1994. For a textbook treatment of this plan, see Agénor and Montiel (1999).

[8] Singh (2006), Singh and Cerisola (2006), and Santiso (2006) highlight the importance of the much improved macroeconomic performance in Latin America in producing better economic outcomes recently. Moreover, Carvalho and Chamon (2006) suggest that the growth of real income that took place after the reforms of the 1990's in Brazil has been severe understimated for methodological reasons.

utilise, as suggested by Fischer (1993) and Besley and Burgess (2003), national data to construct a more disaggregated subnational data set, which we believe better pinpoints the importance of inflation on financial development in a country so regionally diverse in terms of economic outcomes. Furthermore—to carry out the study, and in addition to the time series $T \to \infty$ data—we take advantage of the novel panel time series $T \succ N$ analysis, which deals with important empirical issues—bias in dynamic panels, heterogeneity bias, and between-region dependence—not discussed in the previous empirical studies, to get better and more informative estimates. Additionally, this is particularly important because this sort of analysis does not suffer from the usual criticism applied to cross-sectional data and analysis, e.g. that since a period of high inflation is normally followed by a period of low inflation, high inflation's detrimental effects would be cancelled by low inflation[9].

Secondly, we take into consideration the problem of financial repression existent in Brazil during the high-inflation period, and therefore use an extra measure of financial development that to some extent accounts for this problem. All in all, we fill in an important blank in the literature by exploring national and subnational data, with time-series and regional variation, from an important developing country that provides a rich ground to study and better understand the impact of inflation on finance.

The remainder of this paper has the following structure: Section 4.2 describes the data set used, and also presents some correlations and regression plots of the main variables. Section 4.3 explains the empirical strategy utilised and reports the main results obtained. Section 4.4 concludes the paper: it summarises the importance of the results and their implications in terms of policy, it acknowledges some limitations in terms of data availability, and it suggests future work.

2 The Data

2.1 Description of the Data

The data set we use comes from the Brazilian Institute of Geography and Statistics (IBGE), which is the Brazilian Census Bureau, the Brazilian

[9] See Bruno and Easterly (1998).

Central Bank (BACEN), and the Institute of Applied Economic Research (IPEA) files. The IPEA is an agency of the Brazilian government that, among other activities, compiles primary and provides secondary data from a variety of national and international sources.

This data set covers the period between 1985 and 2002 and ten regions, i.e. from North to South; Pará (PA), Ceará (CE), Pernambuco (PE), Bahia (BA), Distrito Federal (DF), Minas Gerais (MG), Rio de Janeiro (RJ), São Paulo (SP), Paraná (PR) and Rio Grande do Sul (RS). To briefly illustrate the importance of these regions in the national context, they accounted for 49 percent of the total population and 83 percent of the total domestic product in 1995. Moreover, in terms of regional variation, this data set includes a Southern region like São Paulo, with a per capita domestic product of around R$ 10 billion, and also a region like Pará in the North of the country, with a per capita domestic product of roughly R$ 3 billion in 1995. Furthermore, although Brazil is, in fact, divided into 27 regions, there is not any data set with more national coverage than the one used here.

The data used to construct the measures of financial development are originally from the BACEN's Monthly Bulletin (monetary aggregates), and IBGE's National Accounts System (domestic products). The first annualised monetary aggregate used is the usual m2, and it is defined as money in circulation in the economy plus current account and saving deposits in the financial institutions. The second monetary aggregate, m3, is defined as m2 plus other financial assets which are more illiquid, but with higher rates of nominal and real returns than the ones in m2. Moreover, credit to the private sector (credit) and personal credit (personal) are defined respectively as credit provided by public and private financial institutions to firms and to individuals, and individuals only. The reason for including credit provided by the public financial institutions is because in Brazil they offer the general public the usual commercial financial services that are normally provided only by private institutions. All these monetary aggregates are deflated by the IBGE's National Index of Consumer Prices (INPC).

The regional and national Gross Domestic Products (GDPs), and regional Financial Domestic Products (FDPs)—which accounts for the gross domestic product of the financial sector by region—are calculated at market prices and deflated by the IBGE's GDP implicit deflator.

We can then calculate the ratios $m2/GDP$, $m3/GDP$, $credit/GDP$ and

$personal/GDP$ at regional and national levels to obtain $M2$, $M3$, $CREDIT$ and $PERSONAL$, respectively. To calculate these measures at national level we only have to use the information on the national monetary aggregates over the national GDPs. To construct the regional measures of financial development we have to take into account the fact that the data on monetary aggregates are provided only at national level. We therefore use the available national data on monetary aggregates divided by the regional domestic products, and multiplied by the percentage participation of each region in the national Financial Domestic Product to construct our regional proxies for financial development.

The reason for doing so is that otherwise the most developed regions of the South would not appear as financially developed as they actually are. More specifically, with this weighting, the measures of financial development (re) capture more accurately the regional variation in financial development existent among the different regions of Brazil. For example, the Distrito Federal (where the federal capital Brasília is located), São Paulo and Rio de Janeiro, regain their places among the most financially developed regions after the weighting. Definitions 4.1 and 4.2 illustrate the regional (FD_{it}) and national (FD_t) measures of financial development respectively.

$$FD_{it} = (mon.aggregates_t/gdp_{it})fdp_{it}, \tag{1}$$

where fdp_{it}= fdp_i/fdp_t, and

$$FD_t = mon.aggregates_t/gdp_t. \tag{2}$$

Furthermore, the reason for using $M3$ in addition to the usual $M2$, is because during the high-inflation period, Brazil presented the problem of financial repression—the government kept the basic nominal interest rates artificially low, generating with that negative real interest rates—and therefore a low $M2$[10]. Additionally, the measure $PERSONAL$ captures credit being allocated to individuals who might lack the collateral available to, e.g. firms, and captured by the usual $CREDIT$. We therefore believe that these extra measures provide a more accurate view of finance in Brazil at the time for, firstly, broadening the usual $M2$ to account for assets that,

[10] Agénor and Montiel (1999), and Easterly (2002), cover the issue of financial repression in developing countries in general.

although less liquid, would not suffer as much from financial repression and high inflation for having higher rates of returns (not to mention higher levels of indexation), and secondly, for narrowing the usual $CREDIT$ to account for those resources being allocated at a more individual level.

That said, the data on the rates of inflation ($INFL$) come from the IBGE's regional Consumer Price Indexes (IPCs) and the national INPC. The IPCs cover the ten mentioned regions, and families residing in those regions and whose heads are earning the equivalent to eight times the monthly national minimum wage. This regional information is then compiled and aggregated by the IBGE, using the resident population in each region as weight, to form the national INPC itself. The advantage of these indexes is that, as mentioned above, the IBGE is the institution that covers the Brazilian territory most thoroughly, and therefore there is not any other alternative with more regional variation and coverage than the IPCs and INPC themselves[11].

The other macroeconomic control variables utilised are the regional government expenditure over the regional GDPs (GOV), and the already defined regional Financial Domestic Product (FDP), which accounts for the domestic product of the financial sector in each region. GOV encapsulates all expenditure on current public services provided, including education and health, by regional governments. The expenditure by the regional governments are deflated by the IBGE's INPC and the data come from the IPEA files.

2.2 Behaviour of the Data

The rates of inflation were notoriously high and volatile during the 1980s and first half of the 1990s in Brazil. The two most visible hyperinflationary bursts happened in 1989-1990—1,863 percent in 1989, and 82 percent in March 1990—and then again in 1994 (2,489 percent in 1993). However, after July 1994, with the implementation of the Real Plan, inflation has been consistently stable and much lower than previously[12].

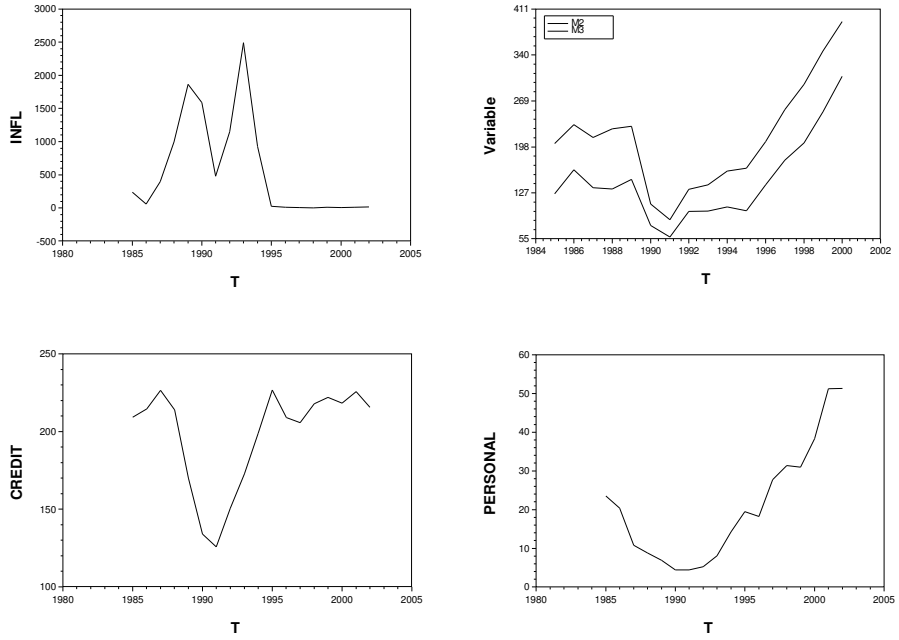
About the measures of financial development, it can be said that all measures presented sharp reductions right before, during and after the first

[11] For more on these price indexes, see Corseuil and Foguel (2002).

[12] It is worth mentioning that, although lower and more stable, the average rate of inflation between 1995 and 2002 is still 9.47 percent.

hyperinflationary burst of 1989-1990—and then again, although less sharply than before—during and after the second burst of hyperinflation in 1993-1994. On the other hand, after the stabilisation of 1994-1995, all measures have experienced a constant increase in their sizes and importance. Figure One illustrates the above using the national time-series variation in the data.

Figure One: Inflation and Financial Development, Brazil 1985-2002.



Source: IBGE, BACEN, IPEA and author's own calculations.

Moreover, we continue to explore this national time-series variation in the data to calculate some statistical correlations and also to investigate whether there is any economic causality among the measures of financial development and inflation. This analysis provides an initial statistical insight into the variation present in the data and it also works as a robustness test for the empirical results based on regional information, which are presented in Section 4.3 below.

Table One provides the correlations between finance and inflation. Firstly, it is seen that all measures of financial development are positively correlated with each other (as it should be), and all correlations are statistically significant at the 5 percent level. Secondly, and most importantly for our purposes here, all measures are negatively correlated with inflation, with

the measures $CREDIT$, $PERSONAL$ and $M3$ being significant at the 5 percent level, and $M2$ being significant at the 10 percent level. It is worth mentioning that $CREDIT$ and $PERSONAL$ (this one being the narrowest and smallest in size of all), present the highest negative correlations with the rates of inflation. This highlights the importance of inflation in affecting those measures that provide funds to be invested in productive activities such as education and physical capital in particular (long run), and, e.g. self-employment activities in general (short run). No less important is the effect of inflation on $M3$, a measure more associated with the provision of indexed assets, and that by nature, would provide some insulation against high inflation during crisis.

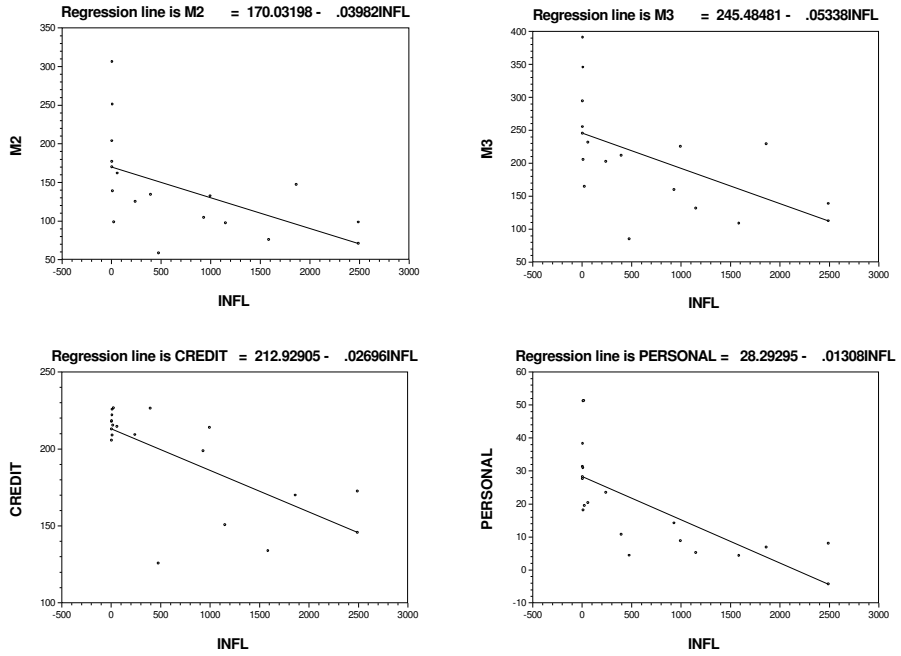
Table One: Correlation Matrix, Financial Development and Inflation, Brazil 1985-2002.

Variables	M2	M3	CREDIT	PERSONAL	INFL
M2	1				
M3	.983*	1			
CREDIT	.596*	.691*	1		
PERSONAL	.857*	.853*	.648*	1	
INFL	-.481**	-.505*	-.635*	-.664*	1

Source: BACEN, IBGE, IPEA and author's own calculations. * significant at the 5 percent level, and ** significant at the 10 percent level.

Additionally, we run univariate OLS time-series regressions to further investigate the statistical-economic relationship existent between inflation and finance. Figure Two shows how the four measures of financial development fared against inflation, and the clear and statistically significant results arising from these regressions is that high and volatile rates of inflation present a clear negative effect on all measures of finance. Moreover, it is important to mention the role of inflation on $M3$, since it presents the largest estimates among all the measures—which highlights that a measure that, in principle, would not suffer from high inflation and financial repression for encapsulating assets which present higher nominal and real returns than the ones provided by $M2$—is in fact heavily affected by the high rates of inflation existent at the time.

Figure Two: Regression Lines, Financial Development and Inflation, Brazil 1985-2002.



Source: BACEN, IBGE, IPEA and author's own calculations. All estimates are statistically significant at the 5 percent level.

In summary, firstly, the above preliminary visual evidence briefly illustrates the behaviour of the national time series data during the period, particularly the fact that during the hyperinflationary periods the measures of financial development presented considerable reductions in their size. This shows that macroeconomic uncertainty, caused by high rates of inflation, is detrimental to finance. More intuitively, the high inflation existent between 1985 and 1994 created a clear sense of uncertainty in terms of expectations of a drastic disinflationary policy that would come at some point with all its costs[13]. This uncertainty, combined with the restrictive stabilisation plans themselves, played a central role in reducing the amount of finance available in the economy at the time.

[13]For instance, the Collor Plan implemented in 1990 was not only a stabilisation attempt based on restrictive monetary policies, but it also confiscated a huge fraction of financial assets in the economy. Furthermore, the Cruzado Plan implemented in 1986 relied heavily on price controls to stabilise high inflation. See Agénor and Montiel (1999) or Kiguel and Liviatan (1992) for more on these Plans.

On the other hand, the somewhat shorter visual evidence covering the period between 1995 and 2002 suggests that finance presented a clear increase at the time, which points to the importance of a stable macroeconomic environment on financial development, and hence on higher savings and credit in the economy. However, since the series are shorter, this effect is still not being picked up by these initial correlation nor regression analysis.

Secondly—and complementary to the above—the statistical correlations among the variables indicate a clear and significant negative statistical relationship between inflation and finance. Furthermore, the univariate OLS time-series regressions to a large extent confirm the visual and descriptive evidence presented, and suggest that an important negative economic relationship exists between inflation and finance in Brazil.

3 Empirical Strategy and Results

3.1 Strategy

The data set we explore in this Section presents time series combined with panel variation. The time series consists of $T = 18$, and the panel of $N = 10$ covering the period between 1985 and 2002. Therefore the empirical strategy utilised is based on the relatively novel panel time series $T \succ N$ analysis. This sort of analysis allows us to deal with issues such as bias in dynamic and heterogeneous panels, and between-region dependence[14].

When we estimate static models, the estimator used is the more appealing one-way Fixed Effects (FE), which allows for heterogeneous intercepts and homogeneous slopes. This estimator is more realistic than the Pooled OLS because the FE works on the assumption that the unobserved regional effects are correlated with the regressors. Therefore, the FE (or Within Groups) estimator explores the within variation in the data and it delivers, given certain conditions, efficient and unbiased estimates of β. More specifically, the FE estimator is OLS on deviations from group means, e.g.

[14] Another issue that could be dealt with in this Chapter is non-stationarity or estimation with I(1) variables in panels. However, Pesaran and Smith (1995), and more fundamentally, Phillips and Moon (1999), or Phillips and Moon (2000), argue that spurious regressions are less of a problem in dynamic panels. This is because the pooled estimators average over the regions and the noise is severely attenuated, and therefore the estimates generated are consistent. Furthermore, Kao, Trapani and Urga (2006) suggest that the above result holds even when spatial dependence is present.

$INFL_{it} = INFL_{it} - \overline{INFL_i}$, where $\overline{INFL_i} = \sum_{t=1}^{T} INFL_{it}/T$. Moreover, $\hat{\beta}$ is consistent for large T and smallish N—which is the case here—and therefore the incidental parameter problem is absent from our analysis[15]. Equation 4.3 illustrates the static equations estimated.

$$FD_{it} = \alpha_i + \beta INFL_{it} + \gamma GOV_{it} + \delta FDP_{it} + u_{it}, \tag{3}$$

where FD_{it} is the particular regional measure-proxy of financial development being estimated, α_i the heterogeneous intercept, $INFL_{it}$ the regional rates of inflation, and the other regional cyclical or control variables, i.e. government expenditure (GOV_{it}) and the Financial Domestic Product (FDP_{it}), and u_{it} the independent normal residuals.

When dynamic models are estimated, the FE estimator provides consistent estimates when $T \to \infty$ and N is fixed, but only when the slopes are *homogeneous*. When *heterogeneous* slopes are present, the estimates provided by the FE estimator become inconsistent, even for large T. Basically, the x_s will not be independent of the lagged y. The indiscriminate use of the FE estimator in this case is to be seen with caution, since it contains a heterogeneity bias problem, and this bias might be severe. However, the Random Coefficients (RC) estimator proposed by Swamy (1970), which allows for heterogenous intercepts and slopes, gives consistent estimates of the expected values. The RC, which can also be interpreted as a Feasible Generalised Least Square (FGLS) estimator, consists of a weighted average of $\hat{\alpha}_i$ and $\hat{\beta}_i$, and the weight contains a modified variance-covariance $\tilde{\Omega}$ matrix of the heterogeneous α_i and β_i[16]. Equations 4.4, 4.5 and 4.6 illustrate the RC-FGLS estimator, and the dynamic and heterogeneous equations estimated respectively.

[15] Zellner (1969), argues that all panel estimators, given some conditions, in fact present unbiased estimates of the expected values in static models.

[16] An alternative to the RC-FGLS is the Mean Group estimator (MG), which consists basically of a simple average of the time-series estimates. However, the MG is sensitive to outliers, a problem not faced by the RC-FGLS estimator. A second alternative is the Instrumental Variable estimator, however an instrument uncorrelated with the residuals is uncorrelated with the explanatory variable, and therefore not a valid instrument. See Pesaran and Smith (1995) for more on heterogeneity bias in dynamic panels, or alternatively Smith and Fuertes (2004). Finally, GMM-type estimators are not an option for the problem of overfitting. See Alvarez and Arellano (2003).

$$\beta = \sum D_i \hat{\beta}_i, \tag{4}$$

$$D_i = \left\{ \sum_i \left[\tilde{\Omega} + V\left(\hat{\beta}_i\right) \right]^{-1} \right\}^{-1} \left[\tilde{\Omega} + V\left(\hat{\beta}_i\right) \right]^{-1}, \text{ where} \tag{5}$$

$$\tilde{\Omega} = \sum_i \left(\hat{\beta}_i - \bar{\beta}\right)\left(\hat{\beta}_i - \bar{\beta}\right)' / N - \sum_i V\left(\hat{\beta}_i\right) / N, \text{ and}$$

$$V(\beta) = \left\{ \sum_i \left[\tilde{\Omega} + V\left(\hat{\beta}_i\right) \right]^{-1} \right\}^{-1}.$$

$$FD_{it} = \alpha_i + \beta_i INFL_{it-1} + \gamma_i GOV_{it} + \delta_i FDP_{it} + \epsilon FD_{it-1} + u_{it}, \tag{6}$$

where the extra FD_{it-1} is the first lag of the measure of financial development being estimated. The use of the first lag of the dependent variable is important, not only because it accounts for the dynamics of finance over time, but also because it works as a proxy for possible omitted variables.

Moreover, since our data set presents $T \succ N$, between-region dependence is believed to be through the disturbances, i.e. $E(u_{it}u_{jt}) \neq 0$. In this case, the covariance matrix $\hat{\Psi}$ of the residuals of the time series regressions can be estimated and used as a weight so that the between-region dependence is captured. Therefore the Seemingly Unrelated Regression (SUR-FGLS) estimator is then used, and its estimates are based on the regional time series, which are in turn averaged by the covariance matrix $\hat{\Psi}$ of the residuals[17]. Equation 4.7 and 4.8 illustrate the SUR-FGLS estimator and the equations estimated, respectively.

$$\beta^{FGLS} = \left(\sum_{t=1}^{T} X_t' \hat{\Psi}^{-1} X_t \right)^{-1} \sum_{t=1}^{T} X_t' \hat{\Psi}^{-1} FD_t, \tag{7}$$

[17] An alternative to SUR-FGLS is the Common Effects Estimator proposed by Pesaran (2006), which includes the means of the explained and explanatory variables in the estimated equation. However, for this estimator to work best N is assumed to be large, and in our data set $N = 10$.

$$FD_t = \alpha_t + \beta INFL_t + \gamma GOV_t + \delta FDP_t + u_t, \tag{8}$$

where all variables estimated account for the regional time series of each variable.

Given the brief review above, it can be said that we deal with the most important empirical issues facing a data set which presents a long T combined with a shorter N. This is important in itself because dealing with these issues implies that we are able to deliver somewhat better and more reliable estimates. Furthermore, the pooled estimators explore the regional links present in the data to improve efficiency and to reduce collinearity, and the SUR-FGLS estimator accounts for excessive between region-dependence in the data and also disaggregates the analysis so that a more insightful view of the results can be obtained. This distinction is relevant because, as Phillips and Sul (2002) point out, if between region-dependence is large, there is little gain in actually pooling the data, instead of using the time-series variation only, as in the RC-FGLS and SUR-FGLS estimator.

All in all, the panel time series analysis utilised provides enough tools to cater for different issues, and also avoids the usual criticism that the cross-section analysis of this subject tends to suffer[18].

3.2 Results

The benchmark static estimates provided by the FE estimator tell us that all measures of financial development are negatively and significantly affected by inflation. $M3$ and $CREDIT$ are the variables presenting the largest negative effects, which highlights that inflation affects the provision of better indexed assets that would otherwise not suffer from inflation and financial repression during high-inflation periods, and also the provision and therefore allocation of credit for investment in all sorts of productive activities.

Of the other macroeconomic control variables included, GOV presents positive effects on financial development, although these are not statistically significant. The reason for the positive sign is because regional government expenditure is more related to expenses on regional infrastructure—

[18] In addition to Bruno and Easterly (1998), see also Clark (1997) for some of the criticism of cross-sectional analysis from an economic point of view. Furthermore, see Phillips and Moon (1999) for some of the advantages of using pooled instead of cross-section analysis, particularly when the variables are believed to be I(1).

including education and health—activities that are conducive of development. FDP delivers a similar picture, i.e. mostly positive effects on finance, however not entirely statistically significant. The economic intuition suggests that when the gross domestic product of financial institutions is on the rise, financial development increases too. The Likelihood Ratio (LR) tests indicate the presence of fixed effects in all equations, which confirms the FE as the right estimator to be utilised. Table Two reports the results.

Table Two: Static Estimates of Inflation on Financial Development, Regions 1985-2002.

	FE			
	M2	M3	CREDIT	PERSONAL
INFL	-.331 (-2.04)	-.460 (-1.88)	-.392 (-1.88)	-.073 (-3.04)
GOV	1.717 (1.53)	1.971 (1.17)	1.457 (1.13)	.158 (1.05)
FDP	.861 (1.25)	1.425 (1.37)	3.378 (3.91)	-.090 (-.89)
R2	.87	.87	.87	.79
F test	87.38	84.43	96.21	53.91
LR test	206.03	204.92	242.57	162.17

T-ratios in parentheses, number of observations: *NT=180*. Source: author's own calculations.

The dynamic equations are estimated by the FE and RC-FGLS estimators respectively. The first half of Table Three below reports the estimates provided by the FE estimator. Inflation presents negative effects on finance, and most estimates are statistically significant. GOV and FDP present the same sort of results as those presented in Table Two, i.e. regional government expenditure is conducive of development, and an increase in the size of FDP leads to more financial development in the economy. The lags of the financial development measures present positive effects on finance, that is to say, past finance generates present finance. The LR tests confirm the existence of fixed effects.

The second half of the table presents the estimates provided by the RC-FGLS estimator. The effects caused by all variables on finance follow the same pattern, i.e. negative effects of inflation on financial development, and positive effects caused by GOV and FDP on finance. $M3$ and $CREDIT$ suffer particularly large effects, stressing the importance of inflation in negatively affecting a measure that is, by definition, more broad than the usual

$M2$ and would not be much affected by financial repression—which highlights that even those with access to $M3$, and all the indexation it provides, would not be entirely insulated against inflation—and also reducing the amount of credit in the economy, with all its deleterious effects. Furthermore, the LR test suggests that the coefficients are in fact *heterogeneous*, which makes the RC-FGLS the most appropriate estimator in this dynamic framework[19]. Table Three reports the results.

Table Three: Dynamic Estimates of Inflation on Financial Development, Regions 1985-2002.

	FE			
	M2	M3	CREDIT	PERSONAL
INFL	-.300 (-2.04)	-.424 (-2.03)	-.116 (-.81)	-.044 (-2.73)
GOV	2.083 (2.04)	2.466 (1.70)	2.199 (2.49)	.330 (3.29)
FDP	1.007 (1.61)	1.674 (1.88)	1.724 (2.85)	.032 (.486)
$M2_{t-1}$	.338 (5.76)			
$M3_{t-1}$		.425 (7.18)		
$CREDIT_{t-1}$			.701 (12.91)	
$PERSONAL_{t-1}$				.503 (11.84)
R2	.89	.90	.93	.89
F test	94.80	102.53	186.65	110.43
LR test	54.89	42.78	12.94	30.68
	RC-FGLS			
INFL	-.274 (-1.84)	-.397 (-2.14)	-.186 (-2.83)	-.038 (1.38)
GOV	1.845 (1.87)	1.749 (1.41)	.853 (.64)	.447 (4.03)
FDP	.775 (1.44)	1.176 (1.66)	.819 (1.97)	.075 (1.38)
$M2_{t-1}$	.436 (4.60)			
$M3_{t-1}$		.493 (5.17)		
$CREDIT_{t-1}$			.419 (4.53)	
$PERSONAL_{t-1}$				.495 (4.93)
R2	.69	.72	.65	.83
LR test	189.32	235.00	279.70	299.74

T-ratios in parentheses, number of observations: *NT=180*. Source: author's own calculations.

[19] Alternatively, in specifications with lagged inflation as an explanatory variable, the same sort of results arise. Available upon request.

Between-region dependence is dealt with by the SUR-FGLS estimator. The more disaggregated and weighted time-series equations confirm the results provided above by the pooled estimators. The impact of inflation on $M2$ and $M3$ is negative and significant in almost all regions. Inflation presents larger estimates against $M3$ than $M2$, and the regions most affected by inflation are the ones located in the more developed South, i.e. the Federal District (DF), São Paulo (SP), Rio de Janeiro (RJ), Minas Gerais (MG), and Rio Grande do Sul (RS). This is quite intuitive because the richest regions are the ones with more advanced financial sectors, and therefore more prone to be affected by volatile rates of inflation. GOV and FDP present the same sort of positive impact on finance, with most estimates being significant. The LM tests suggest that we can not accept the null of independence across regions. Table Four reports the results.

Table Four: SUR-FGLS Estimates of Inflation on Financial Development, Regions 1985-2002.

	SUR-FGLS				
M2	PA	CE	PE	BA	DF
INFL	-.179 (-4.94)	-.269 (-3.18)	-.178 (-2.13)	-.176 (-2.56)	-1.110 (1.48)
GOV	.731 (4.55)	1.398 (3.95)	.592 (1.14)	1.869 (4.89)	8.915 (2.73)
FDP	.605 (5.11)	1.080 (2.86)	.418 (1.37)	.391 (1.61)	6.082 (2.84)
LM test	371.03				
M3					
INFL	-.276 (-5.46)	-.333 (-2.68)	-.297 (-2.52)	-.232 (-2.46)	-.629 (-.54)
GOV	.756 (3.23)	1.986 (4.15)	.222 (.31)	2.691 (4.87)	10.420 (2.02)
FDP	1.010 (5.59)	1.607 (2.91)	.769 (1.70)	.635 (1.88)	6.573 (2.06)
LM test	335.69				
M2	MG	RJ	SP	PR	RS
INFL	-.367 (-6.26)	-.658 (-5.55)	-.730 (-6.10)	-.023 (-.23)	-.408 (-5.36)
GOV	.029 (.14)	1.131 (2.04)	1.168 (1.78)	4.936 (9.15)	.509 (1.02)
FDP	1.103 (6.60)	2.573 (6.56)	1.912 (4.57)	.790 (1.91)	1.003 (2.74)
LM test	371.03				
M3					
INFL	-.524 (-6.46)	-.880 (-4.40)	-.990 (-6.52)	-.1059 (-.75)	-.5551 (-5.63)
GOV	-.735 (-2.58)	.312 (.34)	1.065 (1.41)	6.240 (8.53)	.695 (1.04)
FDP	1.578 (6.68)	3.520 (5.30)	2.711 (4.98)	1.486 (2.66)	1.553 (3.34)
LM test	335.69				

T-ratios in parentheses, number of observations: $NT = 180$. Source: author's own calculations.

When the measures of financial development are $CREDIT$ and $PERSONAL$, the impact of inflation on finance, as we have seen before, is negative and mostly statistically significant. $CREDIT$ suffers larger detrimental effects than $PERSONAL$, and the regions most affected by erratic inflation are the ones with better developed financial sectors in the more developed South. GOV and FDP confirm their roles of being conducive of finance, and most estimates are significant. The LM test rejects, as expected, the null of independence across the regions, therefore suggesting that the SUR-FGLS is an appropriate estimator in this case. Table Five reports the results.

Table Five: SUR-FGLS Estimates of Inflation on Financial Development, Regions 1985-2002.

	SUR-FGLS				
CREDIT	PA	CE	PE	BA	DF
INFL	-.211 (-4.66)	-.138 (-1.38)	-.209 (-2.85)	-.225 (-3.26)	1.259 (1.31)
GOV	.112 (.40)	1.670 (3.87)	.340 (1.03)	.740 (1.63)	13.936 (2.68)
FDP	.591 (2.69)	1.483 (3.23)	1.052 (3.53)	.869 (3.28)	6.992 (2.64)
LM test	249.05				
PERSONAL					
INFL	-.025 (-3.24)	-.071 (-3.23)	-.036 (-2.19)	-.036 (-2.02)	-.267 (-2.77)
GOV	.149 (3.17)	.369 (4.00)	.349 (4.50)	.462 (3.96)	.586 (1.19)
FDP	.097 (2.77)	.203 (2.06)	.119 (1.80)	.098 (1.48)	-.006 (-.02)
LM test	305.49				
CREDIT	MG	RJ	SP	PR	RS
INFL	-.321 (-5.02)	-.721 (-4.82)	-.653 (-6.07)	-.287 (-3.02)	-.363 (-6.54)
GOV	-.243 (-.96)	.072 (.10)	.448 (.67)	.663 (1.62)	1.379 (2.92)
FDP	1.532 (6.78)	3.978 (7.49)	2.326 (5.22)	1.757 (5.23)	1.695 (5.50)
LM test	249.05				
PERSONAL					
INFL	-.058 (-4.55)	-.116 (-6.02)	-.132 (-4.24)	-.023 (-1.14)	-.063 (-3.65)
GOV	.274 (5.36)	.128 (1.60)	.535 (2.78)	.661 (7.37)	.762 (5.42)
FDP	.177 (4.52)	.276 (4.43)	.304 (2.57)	.078 (.99)	.412 (4.54)
LM test	305.49				

T-ratios in parentheses, number of observations: $NT = 180$. Source: author's own calculations.

Given the above evidence, we can comfortably say that the impact of high and erratic rates of inflation on a range of financial development measures is negative and statistically significant. Moreover, the pooled evidence, based on different specifications and panel estimators, clearly points to the fact that the measures $M3$ and $CREDIT$ are the ones being affected more heavily by inflation. This is particularly worrying since $M3$ and $CREDIT$ include respectively financial assets that would not be affected by inflation, for presenting higher rates of nominal and real returns (and hence higher

levels of indexation), and assets that are important for the formation of capital (physical and human) in an economy.

Furthermore, the more disaggregated time series evidence based on SUR-FGLS not only confirms the pooled evidence, but also pinpoints which regions are prone to be more affected by inflation. It is the more financially developed regions which are the ones suffering most with poor macroeconomic performance, therefore depriving the country as a whole of an important engine for enhanced economic growth and development, and for reduced income inequality. On the other hand, it can be said that the poorer regions of the North and the Northeast are not so affected by inflation because they already have a rather small financial sector, i.e. there is a smaller marginal negative effect of inflation on finance in those regions.

With regards to the other macroeconomic control variables, GOV confirms the fact that more government expenditure at regional level is conducive of financial development, and that an increase in FDP leads to more finance being made available in the economy.

4 Concluding Remarks

We examined in this paper the statistical and economic relationship between inflation and financial development in Brazil from 1985 to 2002. The results—based on different data sets, and on a wide range of estimators, specifications and financial development measures—suggest that the high and erratic rates of inflation existent at the time clearly reduced finance in Brazil.

The economic importance and relevance of understanding the macroeconomic determinants of financial development lies in the fact that finance is of crucial importance for key economic variables—i.e. economic growth and development, and income inequality—matters high in the agenda of any developing country, and in particular Brazil. Moreover, given the sort of macroeconomic performance displayed at the time in Brazil, and other developing countries too, inflation arises naturally as a proxy for macroeconomic performance and, hence as a factor that is to have an impact on finance, and its importance is proved by the results shown in Sections 4.2 and 4.3 above.

The statistical importance of the results presented above is because we

explore not only the time series variation, but also the panel time series variation present in the data. We carry out a study based on national and subnational data, which, firstly, is believed to more accurately pinpoint the effects of inflation on finance, and secondly, at least to our knowledge, is believed to be the first time that such a study has been done with Brazilian data.

Furthermore, we employ a range of estimators that appropriately deal with the empirical issues present in this sort of $T \succ N$ data to get better and more informative estimates. The panel time series analysis also, first, avoids the criticism that the cross-section analysis usually suffers, e.g. that periods of different macroeconomic performances end up cancelling each other out, and second, highlights the advantages of pooling with respect to cross-sectional analysis when the variables are expected to be I(1). Moreover, we utilise financial development measures that, firstly take into account the problem of financial repression, and secondly consider the allocation of credit at a more individual and disaggregated level.

Complementary to the above, the results confirm the theoretical prediction, e.g. Choi, Smith, et al. (1996), and Azariadis and Smith (1996) to mention a few, that high rates of inflation are detrimental to financial development, and in addition an economy might suffer the consequences of a small and non-inclusive financial sector. Therefore, the main policy implication of the results is that for a developing country to have an efficient financial sector with all its attached benefits, the rates of inflation have to be low and consistently under control. Poor macroeconomic performance can only bring deleterious effects to a developing economy, i.e. high inequality, erratic growth and low development, and most importantly here, a restrictive financial sector with all its consequences.

A word of caution is necessary though. The data on the monetary aggregates is still only provided at national level by the BACEN. Provision of these sort of data at regional level would certainly bring more flexibility in terms of empirical analysis. Having said that, the measures-proxies we construct capture quite efficiently the regional variation of financial development in Brazil and the absence of regional information cannot be an obstacle to conduct studies in this area. The panel time series estimates presented in Section 4.3 mirror the time-series evidence in Section 4.2. Another interesting development in terms of data would be the provision of data on financial

assets at an individual level. These sort of data would not only make it possible to disaggregate the information we have at the moment even further, and to check whether the poor are really having access to finance, but also to assess how well or badly the debts are being repaid.

A natural extension would be the use of an extended data set covering only the period from 1994 onwards to investigate how the stable economic environment affected finance. Another extension of this work would be an investigation of how inflation and finance affected economic growth and investment in Brazil during the troubled 1980s and 1990s. The main question to be answered would be: did finance compensate for the detrimental effects of inflation on growth and investment? Finally, as Cooley and Hansen (1989), and De Gregorio (1993) suggest, an investigation on the effects of higher inflation on labour supply in different sectors of the economy (e.g. underground economy) in Brazil would also be a natural development to be carried out.

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